

IN THE CLAIMS

1. (Currently Amended) A demodulator, comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals; and

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric.

2. (Cancelled).

3. (Currently Amended) A demodulator, comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal; and

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric

corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by the detected power.

4. (Cancelled)

5. (Currently Amended) A demodulator, comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a ρ -multiplying unit configured to multiply the detected power by a predetermined number ρ ; and

a soft decision demodulated data estimating unit configured to estimate transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ -multiplied value of the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival

path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by a ρ -multiplied value of the detected power.

6. (Cancelled)

7. (Currently Amended) A receiver that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric.

8. (Currently Amended) A receiver that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output the calculated results as 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of

transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram, the soft decision demodulated data being estimated as the product of hard decision data and reliability information, and the reliability information being calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state;

a deinterleaving unit configured to deinterleave the soft decision demodulated data according to a predetermined algorithm; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data after the deinterleaving; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric.

9. (Currently Amended) A receiver that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N (where N

is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by the detected power.

10. (Currently Amended) A receiver that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state;

a deinterleaving unit configured to deinterleave the soft decision demodulated data according to a predetermined algorithm; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data after the deinterleaving; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by the detected power.

11. (Currently Amended) A receiver that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a ρ -multiplying unit configured to multiply the detected power by a predetermined number ρ ;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ -multiplied value of the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by

subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by a ρ -multiplied value of the detected power.

12. (Currently Amended) A receiver that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect a power of the received signal;

a ρ -multiplying unit configured to multiply the detected power by a predetermined number ρ ;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ -multiplied value of the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state;

a deinterleaving unit configured to deinterleave the soft decision demodulated data according to a predetermined algorithm; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data after the deinterleaving; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by a ρ -multiplied value of the detected power.

13. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises:

a convolutional coding unit configured to convolutionally encode the transmitted data;

a converting unit configured to convert the convolutionally-encoded data into a transmission differential phase;

a differential coding unit configured to differentially encode the transmission differential phase and to map the differentially encoded data to the signal phases; and

a transmission signal generation/output unit configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises:

a multiple differential phase detection signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric

corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data,

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric.

14. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises:

a convolutional coding unit configured to convolutionally encode the transmitted data;

an interleaving unit configured to interleave an order of the convolutionally-encoded data according to a predetermined algorithm;

a converting unit configured to convert the interleaved data into a transmission differential phase;

a differential coding unit configured to differentially encode the transmission differential phase and to map the differentially encoded data to the signal phases; and

a transmission signal generation/output unit configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state;

a deinterleaving unit configured to deinterleave the soft decision demodulated data according to the predetermined algorithm; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data after the deinterleaving; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric.

15. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises:

a convolutional coding unit configured to convolutionally encode the transmitted data;

a converting unit configured to convert the convolutionally-encoded data into a transmission differential phase;

a differential coding unit configured to differentially encode the transmission differential phase and to map the differentially encoded data to the signal phases; and

a transmission signal generation/output unit configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a soft decision demodulated data estimating unit configured to estimate transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by the detected power.

16. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises:

a convolutional coding unit configured to convolutionally encode the transmitted data;

an interleaving unit configured to interleave an order of the convolutionally-encoded data according to a predetermined algorithm;

a converting unit configured to convert the interleaved data into a transmission differential phase;

a differential coding unit configured to differentially encode the transmission differential phase and to map the differentially encoded data to the signal phases; and

a transmission signal generation/output unit configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and configured to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by

subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state;

a deinterleaving unit configured to deinterleave the soft decision demodulated data according to the predetermined algorithm; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data after the deinterleaving; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by the detected power.

17. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises:

a convolutional coding unit configured to convolutionally encode the transmitted data;

a converting unit configured to convert the convolutionally-encoded data into a transmission differential phase;

a differential coding unit configured to differentially encode the transmission differential phase and to map the differentially encoded data to the signal phases; and

a transmission signal generation/output unit configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a ρ -multiplying unit configured to multiply the detected power by a predetermined number ρ ;

a soft decision demodulated data estimating unit configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ -multiplied value of the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by a ρ -multiplied value of the detected power.

18. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises:

a convolutional coding unit configured to convolutionally encode the transmitted data;

an interleaving unit configured to interleave an order of the convolutionally-encoded data according to a predetermined algorithm;

a converting unit configured to convert the interleaved data into a transmission differential phase;

a differential coding unit configured to differentially encode the transmission differential phase and to map the differentially encoded data to the signal phases; and

a transmission signal generation/ output unit configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises:

a multiple differential phase detected signal output unit configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) so as to output 1, 2, ..., N symbol differential phase detected signals;

a power detection unit configured to detect power of the received signal;

a ρ -multiplying unit configured to multiply the detected power by a predetermined number ρ ;

a soft decision demodulated data estimating unit configured to estimate transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ -multiplied value of the detected power, wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information, and the reliability information is calculated by subtracting a likelihood for a first survival path metric corresponding to a first survival path that transits into a first state on the trellis diagram from a likelihood for a second survival path metric corresponding to a second survival path that transits into a second state on the trellis diagram, wherein the first state is different from the second state;

a deinterleaving unit configured to deinterleave the soft decision demodulated data according to the predetermined algorithm; and

a decoding unit configured to decode the original transmitted data based on the soft decision demodulated data after the deinterleaving; and

wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase of a first state having a minimum survival path metric on the trellis diagram is the hard decision data, and

the first survival path metric corresponds to the first survival path that transits into the first state having a minimum survival path metric, and the second survival path metric corresponds to the second survival path that transits into the second state having a minimum survival path metric, wherein the reliability information is further multiplied by a ρ -multiplied value of the detected power.